

WE CLAIM:

1. A biopsy device for acquiring a plurality of sequentially biopsied, discrete samples of tissue comprising:
- a rotatable retaining fixture;
  - an elongate outer piercing needle having a sharpened distal end for piercing tissue, said elongate outer piercing needle attached to said rotatable retaining fixture such that said sharpened distal end is held in a fixed position within the tissue mass at a predetermined target position, wherein said elongate outer piercing needle has a lateral opening located proximal to said sharpened distal end for receiving a portion of the tissue mass which is positioned adjacent to said lateral opening;
  - an elongate inner cannula disposed coaxially and slidably within said elongate outer piercing needle, said elongate inner cannula having a sharpened distal end for cutting the portion of tissue protruding into said elongate outer piercing needle lateral opening when said elongate inner cannula slides past said lateral opening thereby depositing the portion of cut tissue within said elongate inner cannula proximal to said sharpened distal end;
  - an inner cannula driver connected to said elongate inner cannula and configured to move said elongate inner cannula axially within said elongate outer cannula; and
  - a tissue sample cartridge having a plurality of tissue sample receptacles, said tissue sample cartridge located proximal to a distal end of said elongate outer cannula and configured to receive the portion of cut tissue which is in said elongate inner cannula proximal to said sharpened distal end when said inner cannula driver withdraws said inner cannula from said outer cannula.
2. A biopsy device as defined in Claim 1 further comprising an elongate knock out pin disposed coaxially and slidably within said elongate inner cannula, said elongate knock out pin having a closed distal end with a vent hole therein.

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2 3. A biopsy device as defined in Claim 2 further  
comprising a vacuum source attached to a proximal end of said  
elongate knock out pin.

2 4. A biopsy instrument comprising:  
a first hollow tubular member having: a longitudinal  
axis; a proximal portion; a distal portion; a tissue  
receiving port positioned laterally a selected distance  
from said distal portion; and a tissue discharge port  
positioned a selected distance from said proximal portion;  
and  
a tissue sample cassette having a plurality of tissue  
sample compartments, wherein each of said tissue sample  
compartments has a tissue receiving port, said tissue  
sample cassette having a plurality of positions with  
respect to said first hollow tubular member tissue  
discharge port such that each of said tissue sample  
compartment receiving ports may be sequentially aligned  
with said first hollow tubular member discharge port.

2 5. A biopsy instrument as defined in Claim 4 further  
comprising:  
a body having a portion arranged to be mounted to a  
stereotactic guidance unit; and  
a rotary drive mechanism mounted to said body and to  
said proximal portion of said first hollow tubular member.

2 6. A biopsy instrument as defined in Claim 4 further  
comprising a first hollow tubular member rotatable retaining  
fixture coupled to said proximal portion of said first hollow  
tubular member, wherein rotation of said fixture controls the  
angular orientation of said laterally disposed tissue receiving  
port.

2 7. A biopsy instrument as defined in Claim 4 wherein said  
first hollow tubular member further comprises a vacuum manifold  
positioned proximal to said laterally disposed tissue receiving  
port.

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2 8. A biopsy instrument as defined in Claim 4 further comprising:

4 a second hollow tubular member having: a longitudinal axis; a proximal portion; a distal portion; a tissue cutting portion positioned a selected distance from said distal portion; wherein said second hollow tubular member is positioned coaxially with said first hollow tubular member, said first hollow tubular member tissue receiving port and said second hollow tubular member tissue cutting portion coacting to sever tissue extending through said tissue receiving port.

2 9. A biopsy instrument as defined in Claim 8 further comprising a second hollow tubular member driving system coupled to said proximal portion of said second hollow tubular member, 4 wherein said second hollow tubular member driving system controls the rotational motion of said second hollow tubular member about said longitudinal axis and the linear motion of 6 said second hollow tubular member along said longitudinal axis.

2 10. A biopsy instrument as defined in Claim 9 wherein said second hollow tubular member driving system further comprises an ultrasonic driver.

2 11. A biopsy instrument as defined in Claim 8 further comprising an elongate knock out pin disposed coaxially and slidably within said second hollow tubular member, said elongate 4 knock out pin having a closed distal end with a vent hole therein.

2 12. A biopsy instrument as defined in Claim 11 further comprising a vacuum source attached to a proximal end of said elongate knock out pin.

2 13. A biopsy method comprising the steps of:  
4 introducing a hollow tubular member having a laterally disposed tissue receiving port located a preselected distance from a distal portion and a tissue discharge port

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6 located at a preselected distance from a proximal portion  
into a tissue mass to be sampled;

8 severing a tissue sample from said tissue mass which  
has entered said tissue receiving port;

10 transporting said severed tissue sample through said  
hollow tubular member to said proximal portion of said  
hollow tubular member; and

12 depositing said severed tissue sample in one of a  
plurality of tissue sample compartments in a sample  
14 cassette.

2 14. A biopsy method as defined in Claim 13 further  
comprising the step of rotating the laterally disposed tissue  
4 receiving port of the hollow tubular member to a predetermined  
angular orientation.

2 15. A biopsy method as defined in Claim 13 further  
comprising the step of applying a vacuum to the laterally  
disposed tissue receiving port of the hollow tubular member.

2 16. A biopsy method as defined in Claim 15 wherein said  
step of applying a vacuum further comprises the step of  
4 distributing the vacuum uniformly over an area defining the  
laterally disposed tissue receiving port of the hollow tubular  
member.

2 17. A biopsy method as defined in Claim 13 further  
comprising the step of maintaining a record of the location in  
the tissue mass from which each tissue sample is acquired.

2 18. A biopsy method as defined in Claim 13 further  
comprising the step of processing the tissue samples for  
4 examination without removing them from the tissue sample  
compartments in the sample cassette.

2 19. A biopsy instrument comprising:  
a hollow piercing needle having a laterally disposed  
tissue receiving port at a distal end and a sample

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4 discharge port at a proximate end, wherein said hollow  
6 piercing needle is mounted on a rotatable positioner for  
controlling the angular orientation of said tissue  
receiving port; and

8 a sample cassette having a plurality of compartments  
coupled to said sample discharge port, wherein each of said  
10 plurality of compartments is correlated with a specific  
angular orientation of said tissue receiving port.

20. A biopsy instrument for extracting intact tissue  
2 samples from within a body comprising:

4 (a) an elongated primary hollow tube with a closed  
distal end;

6 (b) a lateral tissue receiving port near said distal  
end of said elongated primary hollow tube, wherein said  
lateral tissue receiving port is configured for positioning  
8 within the body;

10 (c) a proximal tissue discharge port near a proximal  
end of said elongated primary hollow tube, wherein said  
proximal tissue discharge port is configured for  
12 positioning outside the body; and

14 (d) a tissue specimen cassette containing multiple  
receptacles configured to receive tissue specimens mated to  
said proximal tissue discharge port.

21. A biopsy instrument as defined in Claim 20 further  
2 comprising:

4 (a) an inner hollow tube movably positioned within  
said elongated primary hollow tube, said inner hollow tube  
having a sharpened distal end; and

6 (b) an inner hollow tube driver attached to a  
proximal end of said inner hollow tube, said inner hollow  
8 tube driver configured: 1) to move said inner hollow tube  
past said lateral tissue receiving port thereby cutting off  
10 a tissue specimen and thereby positioning the tissue  
specimen within said inner hollow tube, and 2) to move said  
12 inner hollow tube to said proximal tissue discharge port.

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22. A biopsy instrument as defined in Claim 21 wherein  
2 said inner hollow tube driver is further configured to rotate  
said sharpened distal end of said inner hollow tube to  
4 facilitate cutting.

23. A biopsy instrument as defined in Claim 21 wherein  
2 said inner hollow tube driver is further configured to oscillate  
said sharpened distal end of said inner hollow tube to  
4 facilitate cutting.

24. A biopsy instrument as defined in Claim 21 further  
2 comprising a packing plug located within said distal end of said  
elongated primary hollow tube; said packing plug shaped to mate  
4 with the inside of said distal end of said inner hollow tube to  
pack the tissue specimen within said inner hollow tube.

25. A biopsy instrument as defined in Claim 20 further  
2 comprising:

(a) an outer hollow tube movably positioned outside  
4 said elongated primary hollow tube with a closed distal  
end, said outer hollow tube having a sharpened distal end;

(b) an outer hollow tube driver attached to a  
6 proximal end of said outer hollow tube, said outer hollow  
tube driver configured to move said outer hollow tube past  
8 said lateral tissue receiving port at said distal end of  
said elongated primary hollow tube thereby cutting off a  
10 tissue specimen and depositing the tissue specimen within  
12 said elongated primary hollow tube; and

(c) a driver attached to said proximal end of said  
14 elongated primary hollow tube configured to move said  
elongated primary hollow tube with a closed distal end to  
16 said proximal tissue discharge port.

26. A biopsy instrument as defined in Claim 25 wherein  
2 said outer hollow tube driver is further configured to rotate  
said sharpened distal end of said outer hollow tube to  
4 facilitate cutting.

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27. A biopsy instrument as defined in Claim 25 wherein  
2 said outer hollow tube driver is further configured to oscillate  
said sharpened distal end of said outer hollow tube to  
4 facilitate cutting.

28. A biopsy instrument as defined in Claim 20 further  
2 comprising an elongate knock out pin disposed coaxially and  
slidably within said elongated primary hollow tube, said  
4 elongate knock out pin having a closed distal end with a vent  
hole therein.

29. A biopsy instrument as defined in Claim 28 further  
2 comprising a vacuum source attached to a proximal end of said  
elongate knock out pin.

30. A biopsy instrument as defined in Claim 20 further  
2 comprising a registration mechanism to correlate the orientation  
of said lateral tissue receiving port with a unique tissue  
4 sample cassette sequence number to allow reconstruction of the  
spatial distribution of the collected tissue specimens.

31. A biopsy instrument as defined in Claim 20 further  
2 comprising a vacuum chamber connected to said lateral tissue  
receiving port to actively pull tissue into said lateral tissue  
4 receiving port in said elongated primary hollow tube.

32. A biopsy instrument as defined in Claim 20 further  
2 comprising a proximal longitudinal depth controlling mechanism  
connected to said elongated primary hollow tube configured to  
4 translate said outer hollow tube to selected depths along the  
elongate hollow tube's long axis whereby the biopsy instrument  
6 can extract multiple intact tissue samples longitudinally from  
within a target lesion or organ while, at all times, maintaining  
8 the instrument within the target.

33. A biopsy instrument as defined in Claim 20 further  
2 comprising a proximal rotational drive controlling mechanism  
connected to said elongated primary hollow tube configured to

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4 rotate said elongate hollow tube to selected positions about the  
elongate hollow tube's long axis whereby the biopsy instrument  
6 can extract multiple intact tissue samples radially from within  
a target lesion or organ while, at all times, maintaining the  
8 instrument within the target.

2 34. A biopsy instrument as defined in Claim 20 further  
comprising:

4 (a) a pointed distal end on said elongated primary  
hollow tube with a closed distal end; and

6 (b) a proximal piercing mechanism connected to said  
elongated primary hollow tube with a closed distal end,  
said proximal piercing mechanism configured to translate  
8 said elongated hollow tube to selected depths along said  
elongated hollow tube's long axis whereby the biopsy  
10 instrument can pierce a target lesion from without the  
lesion.

2 35. A biopsy instrument as defined in Claim 20 further  
comprising a guidance system for positioning said elongated  
primary hollow tube, said guidance system selected from the  
4 group including, endoscopy, computed tomography, ultrasound,  
fluoroscopy, stereotaxis, and magnetic resonance imaging.

2 36. A biopsy instrument comprising:

4 (a) an elongated primary hollow tube with a closed  
distal end;

6 (b) a lateral tissue receiving port near said distal  
end of said elongated primary hollow tube, wherein said  
lateral tissue receiving port is configured to receive  
tissue;

8 (c) a vacuum chamber attached to said distal end of  
said elongated primary hollow tube; and

10 (d) a plurality of communicating holes between said  
distal end of said elongated primary hollow tube and said  
12 vacuum chamber to pull tissue into said elongated primary  
hollow tube.

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37. A biopsy method for excavating a large volume of tissue from within a body by repetitively removing smaller tissue specimens through a small opening in the body, the small opening just large enough to withdraw one tissue specimen, said method comprising the steps of:

(a) introducing an elongated primary hollow tube with a closed distal end into the body, wherein the elongated primary hollow tube has a lateral tissue receiving port near its distal end and a proximal tissue discharge port with the proximal tissue discharge port mated to a tissue specimen cassette containing a plurality of specimen compartments;

(b) positioning the lateral tissue receiving port within the body near a target lesion or organ;

(c) positioning the proximal tissue discharge port outside the body;

(d) cutting a tissue specimen which has entered the tissue receiving port;

(e) transporting the cut tissue specimen through the elongated primary hollow tube to the proximal tissue discharge port; and

(f) depositing the cut tissue specimen into a receptacle within the tissue specimen cassette.

38. A biopsy method as defined in claim 37 further comprising the step of rotating the lateral tissue receiving port to a predetermined angular orientation.

39. A biopsy method as defined in claim 37 further comprising the step of translating the lateral tissue receiving port to a predetermined depth within the body.

40. A biopsy method as defined in claim 37 further comprising the step of applying a vacuum to the lateral tissue receiving port to encourage tissue capture.

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2 41. A biopsy method as defined in claim 40 further comprising the step of distributing the vacuum uniformly over an area defining the lateral tissue receiving port.

2 42. A biopsy method as defined in claim 37 further comprising the step of maintaining a record of the orientation of the lateral tissue receiving port and the number of the  
4 chamber in the tissue specimen cassette to allow special correlation of the origin of each specimen.

2 43. A biopsy method as defined in claim 37 further comprising the step of packing the tissue specimen into a transport means with a packing plug.

2 44. A biopsy method as defined in claim 43 further comprising the step of ejecting the tissue specimen from the transport means into the tissue specimen cassette.

2 45. A biopsy method as defined in claim 37 further comprising the step of piercing the target lesion by actively driving the elongated primary hollow tube from without the  
4 targeted lesion to within the lesion.

2 46. A biopsy device comprising:  
a housing;  
4 a tubular piercing member having a distal pointed end, and a laterally positioned tissue receiving port proximate said distal pointed end which opens into a tissue sample  
6 chamber, wherein said tubular piercing member is rotatably attached to said housing and held in an axially fixed  
8 position within a tissue mass; and  
10 a cannular cutting member coaxing with said tubular piercing member to cut a first tissue sample from the  
12 tissue mass such that the first tissue sample can be transported to a proximate end of said tubular piercing member.

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Add 42